



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| (21) International Application Number: PCT/US00/04683 (22) International Filing Date: 24 February 2000 (24.02.00) (30) Priority Data: 60/121,452 24 February 1999 (24.02.99) US (71) Applicant: SHELL OIL COMPANY [US/US]; 900 Louisiana, P.O. Box 2463, Houston, TX 77252-2463 (US). (72) Inventors: NAZZAI, Gregory, Richard; 3918 Laurel Rock Drive, Kingwood, TX 77345 (US). FRANK, Timothy, John; 16211 Hickory Point Road, Houston, TX 77095 (US). COON, Robert, Joe; 4603 Misty Hollow Drive, Missouri City, TX 77459 (US). (74) Agent: STEINBERG, Beverlee, G.; Shell Oil Company, 900 Louisiana, P.O. Box 2463, Houston, TX 77252-2463 (US). | | (81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> |
| (54) Title: SELECTIVE ZONAL ISOLATION WITHIN A SLOTTED LINER (57) Abstract <p>Selective isolation of a zone within a slotted liner completion of a wellbore is accomplished by expanding the original slotted liner to the full inner diameter of the wellbore into the annular area normally found around slotted liners. At least one solid tubular is run into the expanded area of the slotted liner and expanded at least in that section of the wellbore to be isolated. A custom expandable slotted liner can be run and expanded within the existing expanded slotted liner if excessive splits or rips should occur in the existing slotted liner due to expansion. Epoxies, rubber, or other sealing materials can also be utilized to better effect a seal between the liners.</p> <div data-bbox="787 1144 1372 1942" data-label="Image"> </div> | | |

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DESCRIPTIONSELECTIVE ZONAL ISOLATION WITHIN A SLOTTED LINERTechnical Field

The present invention relates to a method to provide isolation within a zone of a wellbore lined with a slotted liner by placing an expandable liner within the zone to be isolated.

5 Background Art

There is a great deal of prior art relating to isolating portions of a wellbore for various reason. For example, a zone may be producing water or gas and needs to be shut off for more effective production of the petroleum being recovered. Also,
10 a zone may be producing sand or collapsing and creating debris and needs to be isolated to maintain an efficient operation. However, different problems arise when the wellbore has been completed with the insertion of a known slotted liner.

One example of the prior art is U.S. Pat. No. 5,366,012
15 which describes a method of completing uncased sections of a wellbore by placing, at a predetermined position in the wellbore, a liner which is provided with a plurality of overlapping slots. The upper end of the liner is fixed in place and an upwardly tapering expansion mandrel is drawn upwardly through the slotted
20 liner expanding it outwardly to engage the walls of the wellbore. This circumferentially outward movement is facilitated by the opening of the slots, together with a slight shortening of the overall length of the liner. Slotted liner completions of this type leave an annular area around the slotted liner which makes
25 zonal selectivity nearly impossible.

Another suitable method for sealing between a lining and wellbore, casing or pipeline is shown in U.S. Pat. No. 5,494,106. This patent describes a deformable annular seal which

is lowered into the wellbore in a deformed or contracted state, which does not impede insertion. Once in place the seal is expanded. During expansion of the seal it is hardened to form a substantially permanent repair.

5 Another method for lining a casing is shown in U.S. Pat. No. 5,454,419 in which a tubular polymeric material is lowered into the wellbore in a stretched condition, due to a series of weights attached to the leading or bottom end. When properly positioned, the weights are released and the tubular
10 material returns to its normal condition in which it presses against the walls to the wellbore.

Disclosure of the Invention

The present invention provides a method to provide selective isolation within a zone of a well lined with an
15 expanded slotted liner, comprising the steps of:

fully expanding said expanded slotted liner within the wellbore to contact substantially the entire surface of the wellbore adjacent said liner;

placing at least one additional expandable
20 substantially imperforate liner within a zone of the original expanded liner to be isolated; and

expanding said at least one additional expandable liner into sealing contact with the original expanded slotted liner at least adjacent the ends of the zone to be isolated whereby the
25 desired zone of the wellbore is isolated from the formation.

The selective zonal isolation system of the present invention can be utilized within a slotted liner completion to selectively isolate, either permanently or temporarily, sections of the wellbore for such applications as fluid shutoff or
30 stimulation purposes. The subject selective zonal isolation system works by first expanding an existing slotted liner in the wellbore to the full inner diameter of the hole. Then one or more

solid tubular members are run into the expanded area and are expanded at least in that section of the wellbore to be isolated.

It is also possible to use expandable packers to selectively isolate the section. Additionally, if excessive
5 splits or rips should occur in the existing slotted liner, after expansion, a custom second expandable slotted liner can be run into the wellbore and expanded within the original expanded slotted liner. Epoxies, rubber, or other sealing materials can also be utilized to better effect a seal. The same methodology
10 could also be utilized in solid uncemented pipe sections to increase the effective wellbore radius. Benefits are sealing or zonal isolation of existing slotted liner, perforated pipe, sand control device or open hole or other completion system.

Brief Description of the Drawings

15 The present invention will now be described, by way of example, with reference to the accompanying drawings in which:

Fig. 1 is a vertical section through a portion of a wellbore with an expandable liner in place;

Fig. 2 is a vertical section similar to Fig. 1 showing
20 the wellbore after expansion of the liner;

Fig. 3 is a vertical section of the same well with the secondary liner in position; and

Fig 4. Is a vertical section through the well of Fig. 3 with the sealing liner in place.

25 Detailed Description of a Preferred Embodiment

The wellbore 10 (Figs. 1 and 2) has a first expandable liner 12 in place and running through a zone of the wellbore to be isolated. Generally this first liner, when expanded, does not fully contact all surfaces of the wellbore and it can contain a
30 number of tares and/or rents in the slots. A second liner 14 (Figs. 3 and 4) is inserted into the wellbore and positioned to cover at least the zone of the wellbore 10 to be isolated. Then

the second liner 14 is expanded to sealing engage the first expanded slotted liner 12 sealing the openings therein to isolate that portion of the wellbore. This sealing can be improved by the addition of sealing materials (not shown), such as epoxies, rubber and the like.

While only a single second liner 14 has been shown, it is within the scope of the present invention to include insertion of more than one second liner. It is also within the scope of the invention that these second liners have physical characteristics different from one another so that, for example, a first liner would have characteristics suitable for withstanding high pressures while the next liner would have characteristics suitable for withstanding erosive effects of the flow through the wellbore.

It should be noted when any slotted liner is expanded, many things can happen to it since wellbores are never smooth cylinders. For example, while it is hoped that the majority of the slots will open as expected allowing the slotted liner to expand, the wellbore walls are never uniform and expansion will be at various rates in different directions and for different distances. This variation in expansion can stress the slotted liner producing tears, rents and other openings which, while not adversely affecting the task of the slotted liner, can result in problems for subsequently sealing portions of the wellbore protected by such a slotted liner.

The selective zonal isolation system of the present invention can be utilized within a slotted liner completion to selectively isolate, either permanently or temporarily, sections of the wellbore for such applications as fluid shutoff or stimulation purposes. Current slotted liner completions leave an annular area around the slotted liner which makes zonal selectivity nearly impossible. The selective zonal isolation

system according to the present invention works by first expanding the current slotted liner to the full inner diameter of the wellbore, running at least one solid tubular liner into the expanded area and expanding at least that section of the tubular liner in the area to be isolated. Additionally, if excessive splits or rips should occur in the existing slotted liner after expansion, a custom expandable slotted liner (not shown) can be run into the wellbore and expanded within the existing expanded slotted liner. Epoxies, rubber, or other sealing materials (also not shown) can also be utilized to better effect a seal between the expanded slotted liner and the tubular liner.

The same methodology of the present invention could also be utilized in solid uncemented pipe sections to increase the effective wellbore radius.

While a metal tubular liner has been shown in the drawings, the liner is not so limited. The tubular liner could be made from a wide variety of metals and plastics materials. For example, a memory metal could be used. The tubular liner would be formed on the surface, deformed for insertion into the wellbore, and reformed when in position. Likewise, the tubular liner could be formed and folded or compressed and later expanded or reformed when it position by use of a mechanical device such as a mandrel or an inflatable member, or by a hydro-pneumatic force, including an explosive force.

Benefits of the present invention include sealing or zonal isolation of existing slotted liner, perforated pipe, sand control device or open hole or other completion system.

The present invention may be subject to many modifications and changes which would occur to one skilled in the art. Thus, the described embodiment should be considered in all

respects as illustrative and not restrictive of the scope of the subject invention as defined by the accompanying claims.

CLAIMS

1. A method to provide selective isolation within a zone of a well lined with an expanded slotted liner, comprising the steps of:

5 fully expanding said expanded slotted liner within the wellbore to contact substantially the entire surface of the wellbore adjacent said liner;

placing at least one additional expandable substantially imperforate liner within a zone of the original
10 expanded liner to be isolated; and

expanding said at least one additional expandable liner into sealing contact with the original expanded slotted liner at least adjacent the ends of the zone to be isolated whereby the desired zone of the wellbore is isolated from the formation.

15 2. The method according to claim 1 wherein said sealing is permanent.

3. The method according to claim 1 or 2 wherein said at least one additional expandable liner is inserted in a compressed condition and released when in position, or is
20 inserted in a collapsed condition and expanded when in position.

4. The method according to any of claims 1-3 wherein said at least one additional expandable liner is formed of a memory retentive material which is initially formed, then deformed to allow insertion into the wellbore, and its memory
25 activated to expand the liner to its original shape and seal the selected zone of the wellbore.

5. The method according to any of claims 1-4 wherein said at least one expandable liner is formed from metal or a plastics material.

30 6. The method according to any of claims 1-5 wherein each said at least one expandable liner has different physical characteristics from a preceding liner whereby different

characteristics of flow through the wellbore, such as pressure and erosion, can be addressed.

7. The method according to any of claims 1-6 wherein said expansion is accomplished by use of a mandrel, an explosive
5 force, or pressurized fluid.

8. The method according to any of claims 1-7 further comprising the step of:

applying sealing materials to effect a better seal between said slotted liner and said at least one expandable
10 liner.

9. A selective zonal isolation system which can be utilized to selectively isolate, either permanently or temporarily, sections of a wellbore within a slotted liner completion for such applications as fluid shutoff or stimulation
15 purposes, comprising:

expanding the existing slotted liner to substantially that of the inner diameter of the wellbore;

running at least one expandable imperforate liner into the zone to be isolated; and

20 expanding said at least one liner to sealingly engage said slotted liner at least adjacent the ends of said zone to be isolated.

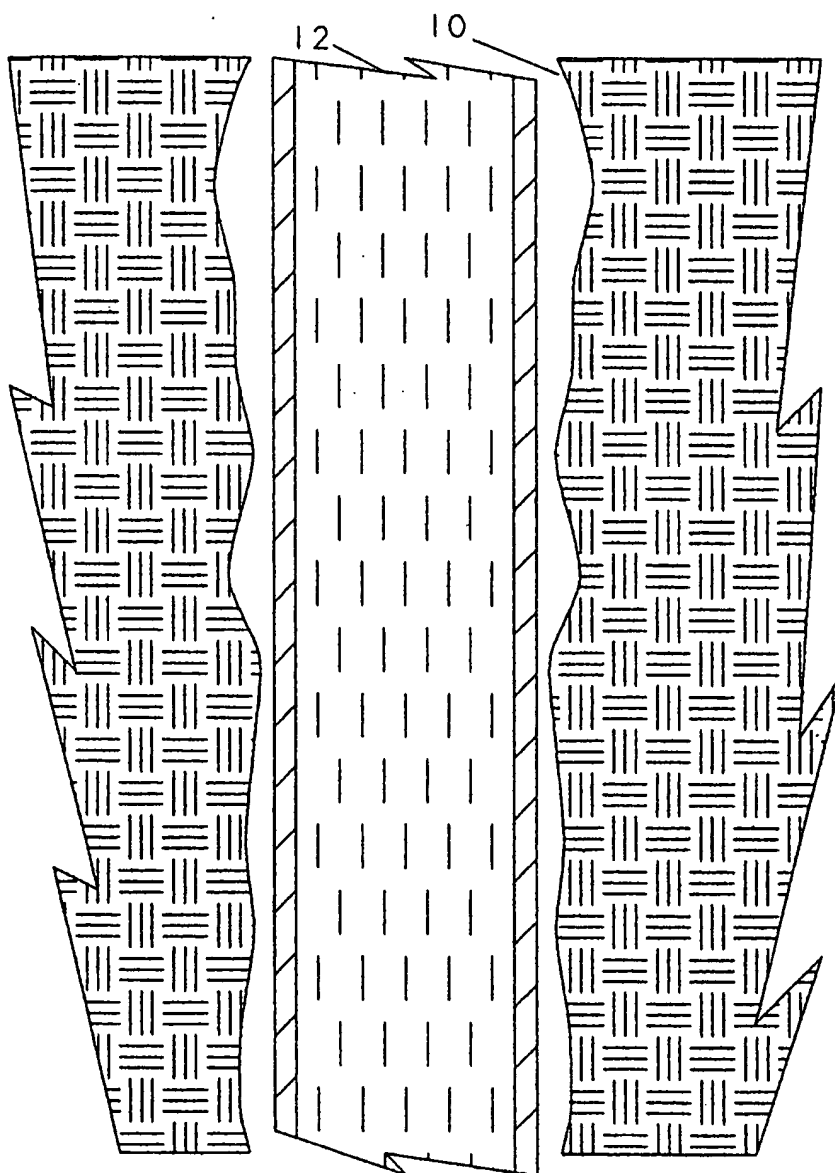


FIG. 1

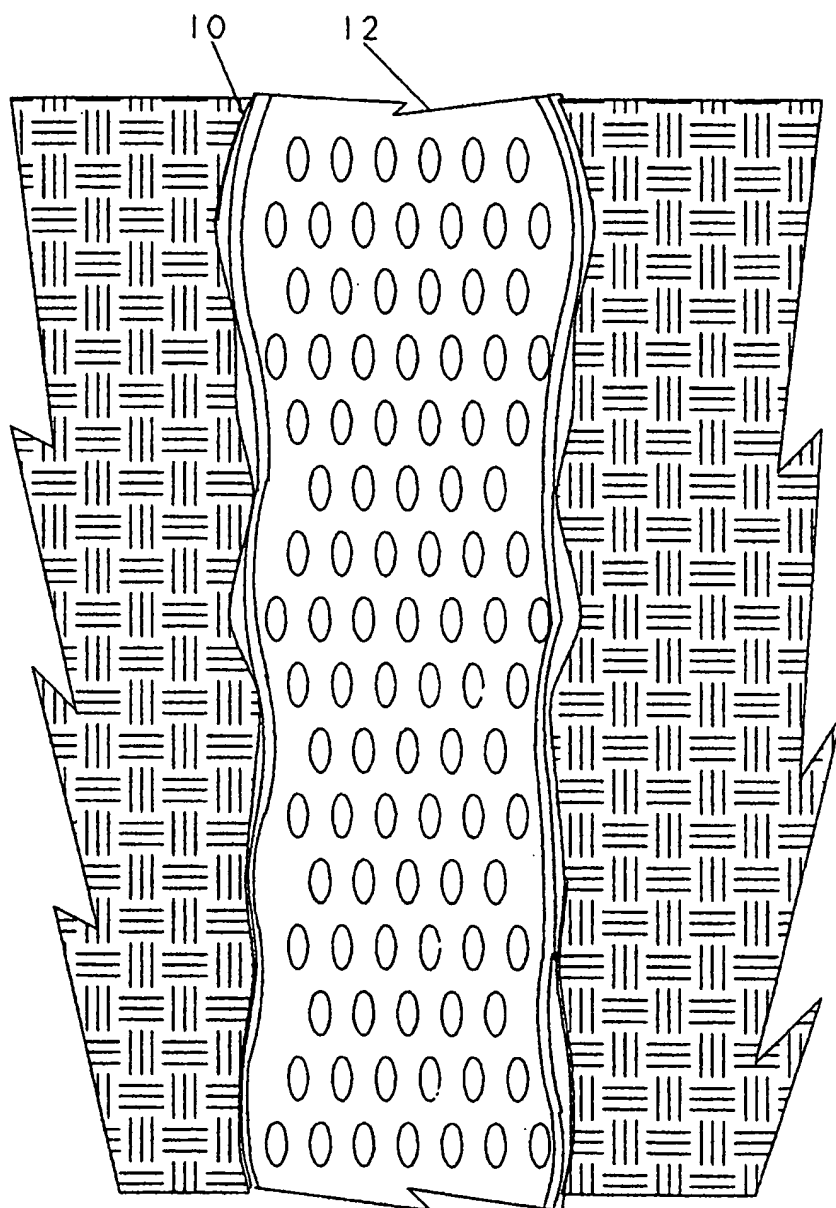


FIG. 2

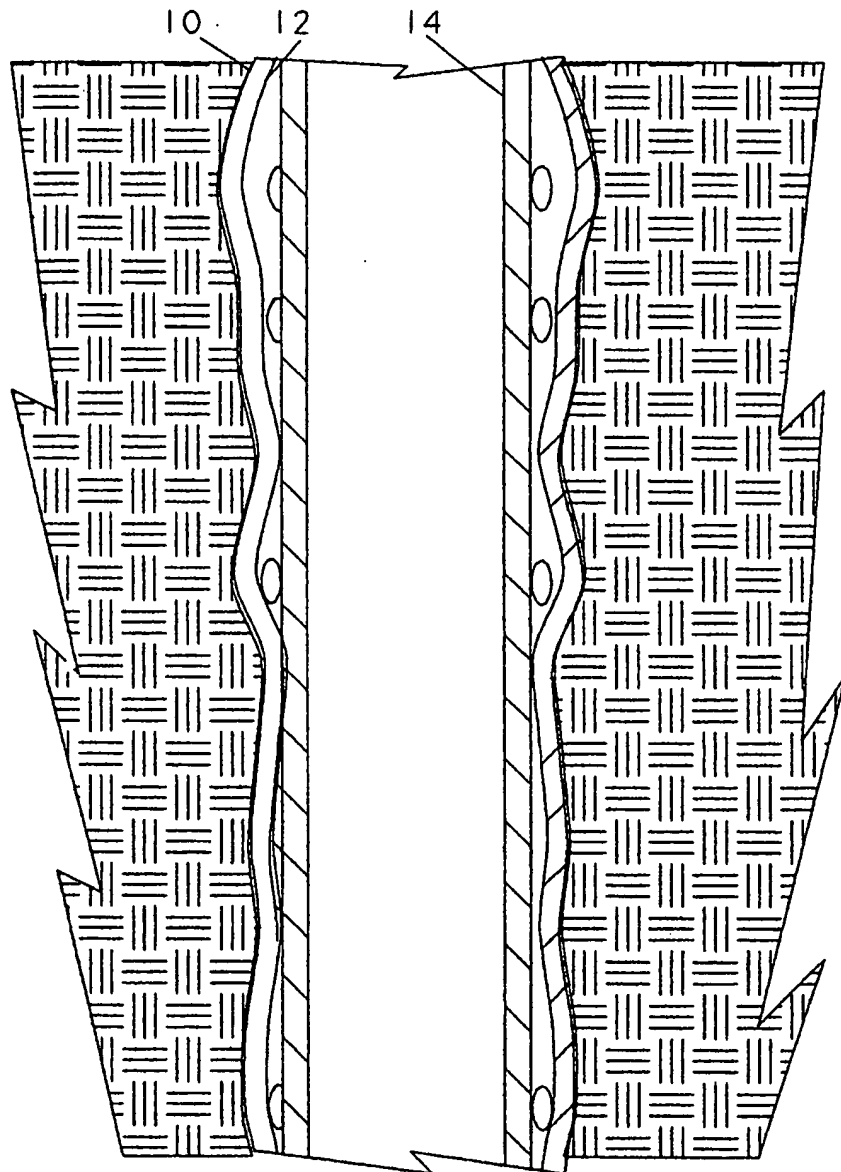


FIG. 3

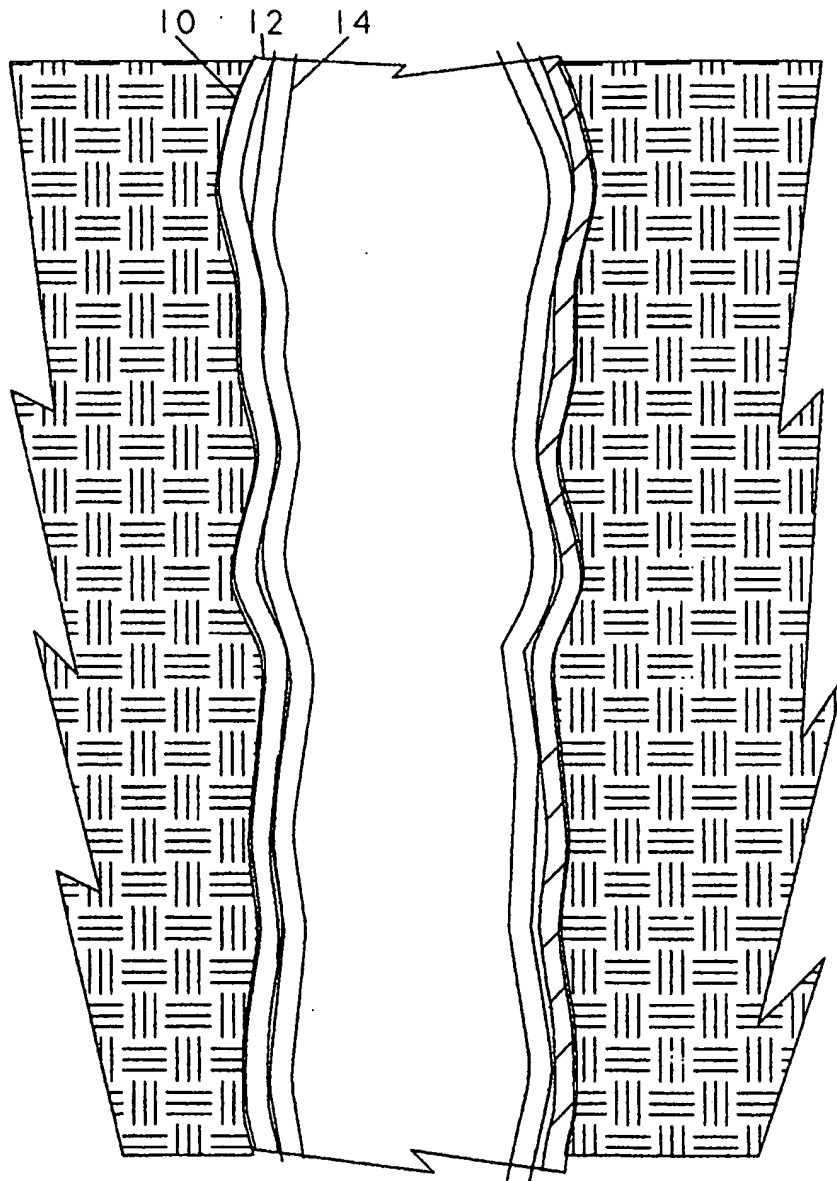


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 00/04683

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E21B43/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|-----------------------|
| A | US 4 865 127 A (KOSTER CHARLES H) 12 September 1989 (1989-09-12) column 1, line 40 - line 55 | 1,9 |
| A | US 4 872 509 A (DICKINSON BEN W O ET AL) 10 October 1989 (1989-10-10) column 4, line 68 -column 5, line 4 column 5, line 66 -column 6, line 8 | 1,9 |
| A | US 3 918 520 A (HUTCHISON STANLEY O) 11 November 1975 (1975-11-11) abstract | 1,9 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|--|--|
| US 4865127 A | 12-09-1989 | AU 2942389 A CA 1310261 A EP 0357711 A NO 893597 A WO 8906738 A | 11-08-1989 17-11-1992 14-03-1990 07-09-1989 27-07-1989 |
| US 4872509 A | 10-10-1989 | US 4750561 A AU 605122 B AU 6673286 A BR 8606305 A CA 1297782 A DE 3686478 A DE 3686478 T EP 0227456 A MX 160919 A US 4865128 A US 5035285 A | 14-06-1988 10-01-1991 25-06-1987 06-10-1987 24-03-1992 24-09-1992 21-01-1993 01-07-1987 19-06-1990 12-09-1989 30-07-1991 |
| US 3918520 A | 11-11-1975 | AU 502025 B AU 8531975 A CA 1034489 A NL 7511520 A NO 753294 A, B, US 3960212 A | 12-07-1979 07-04-1977 11-07-1978 01-04-1976 31-03-1976 01-06-1976 |